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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/050,195
Filing Date: January 16, 2002
Appellant(s): KANG ET AL.

D. Scott Moore
For Appellant

MAILED
SEP 7 2004
GROUP 2800

EXAMINER'S ANSWER

This is in response to the appeal brief filed June 7, 2004.

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(1) *Real Party in Interest*

A statement identifying the real party in interest is contained in the brief.

(2) *Related Appeals and Interferences*

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) *Status of Claims*

The statement of the status of the claims contained in the brief is correct.

(4) *Status of Amendments After Final*

No amendment after final has been filed.

(5) *Summary of Invention*

The summary of invention contained in the brief is correct.

(6) *Issues*

The appellant's statement of the issues in the brief is correct.

(7) *Grouping of Claims*

Appellant's brief includes a statement that claims 4-6 and 25-32 do not stand or fall together and provides reasons as set forth in 37 CFR 1.192(c)(7) and (c)(8).

(8) *Claims Appealed*

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) *Prior Art of Record*

5,672,543	Chang et al.	9-1997
6,107,190	Taguwa et al.	8-2000

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6,534,809	Moise et al.	3-2003
6,300,683	Nagasaka et al.	10-2001

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1 and 3-5 are rejected under 35 U.S.C. 102(b) as being anticipated by Chang et al. (US 5,672,542), hereinafter Chang.

Regarding claim 1, Fig.1 of Chang shows a semiconductor device comprising:

a substrate 10;

an insulating layer 20 disposed in a gap on the substrate;

a liner layer 26 exhibiting compressive stress characteristics (col. 1, lines 32-33) disposed on sidewalls of the insulating layer;

a contact plug 28 exhibiting tensile stress characteristics (col. 1, lines 53-54) directly on the liner layer.

Regarding claim 3, the liner of Chang inherently possesses an amorphous structure since since it is deposited by PVC.

Regarding claim 4, Fig.1 of Chang shows a semiconductor device further comprising an ohmic layer 24 disposed between the liner and the sidewalls of the insulating layer, and between the liner and the substrate.

Note that the titanium layer 24 is an ohmic layer since the metal (titanium) is deposited by PVD on the semiconductor conductive layer 14.

Regarding claim 5, Chang discloses an ohmic layer comprises titanium (col. 1, line 16).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 2 and 8-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Taguwa et al. (US 6,107,190) hereinafter Taguwa.

Regarding claim 2, Chang discloses substantially the entire claimed device except a TiN contact plug. Taguwa discloses in Fig. 1D a TiN contact plug 84 (col. 2, lines 33-39).

It would have been obvious to one of ordinary skill in the art at the time of the invention to form a TiN plug in the device of Chang with Taguwa's teachings in order to reduced a production cost as taught in column 1, lines 57-61 of Taguwa.

It is also well known TiN is an art recognized equivalent of the contact plug material to the one (W; tungsten) in Chang's device.

Regarding claims 8-10, Fig.1D of Taguwa shows an aluminum layer 85 (col.3, line 18).

5. Claims 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Moise et al. (US 6,534,809), hereinafter Moise.

Regarding claims 11-13, Chang discloses substantially the entire claimed device except a capacitor structure on the contact plug. Fig.1 of Moise shows a capacitor 125 formed on a contact plug 114 and a capacitor with a lower electrode 124 made of Pt (col. 9, lines 27-39).

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate Moise's teachings to Chang's device in order to form a capacitor structure on the contact plug for fabrication of a DRAM array which requires a charge storage capacitor.

6. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Nagasaka et al. (US 6,300,683), hereinafter Nagasaka.

Regarding claim 14, Chang discloses substantially the entire claimed device except a shape of the contact plug. However, Fig. 19D of Nagasaka shows a tapered contact plug 12.

It would have been obvious to one of ordinary skill in the art at the time of the invention to form a tapered contact plug of Chang with Nagasaka's teaching in order to form the plug without cracks. It is also well known in the art that it is easier to fill contact/plug openings with tapered sidewalls.

7. Claims 25-29, 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang and Taguwa in view of Moise.

Regarding claim 25, Fig.1 of Chang shows a contact plug in an insulating layer 20 having tensile stress (col. 1, lines 53-54), a TiN layer 26 surrounding the plug on contact and having

compressive stress (col. 1, lines 32-33) and an ohmic layer 24 between the insulating layer and the TiN layer.

The aspect regarding the ohmic layer has been discussed in detail in claim 4.

Chang discloses substantially the entire claimed device except a TiN plug having tensile stress. Fig. 1D of Taguwa shows a TiN plug having a tensile stress (col. 2, lines 33-39).

It would have been obvious to one of ordinary skill in the art at the time of the invention to form a TiN plug in the device of Chang with Taguwa's teachings in order to reduced a production cost as taught in column 1, lines 57-61 of Taguwa.

The device with the teachings of Chang and Taguwa fails to show that a capacitor structure with a lower conductive layer and an upper conductive layer, contacting the upper surface of the TiN plug. Fig.1 of Moise shows a bottom conductive layer (bottom electrode; 124) and an upper conductive layer (top electrode; 128) of a capacitor 125 formed on a TiN contact plug 114 (col. 7, line 39 – col. 10, line 49).

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate Moise's teachings to the device of Chang and Taguwa in order to form a capacitor structure on the contact plug for fabrication of a DRAM array which requires a charge storage capacitor.

Regarding claim 26, Taguwa discloses a TiN plug formed by CVD (col.1, lines 57-61). Regarding claim 27, Chang discloses a TiN layer formed by CVD (col. 3, lines 13-14). In addition, CVD, ALD, CVD AND ALD are a process designation and would thus not carry patentable weight in this claim drawn to a product. See *In re Thorp*, 227 USPQ 964 (Fed. Cir. 1985).

Regarding claim 28, Chang discloses a TiN layer has an amorphous crystal structure since it is deposited by PVC.

Regarding claim 29, Chang discloses a TiN liner formed by physical vapor deposition (col. 3, line 13).

In addition, IPVD is a process designation and would thus not carry patentable weight in this claim drawn to a product. See *In re Thorp*, 227 USPQ 964 (Fed. Cir. 1985).

Regarding claim 31, Moise shows the upper conductive layer made of Pt (col.9, lines 30-33).

Regarding claim 32, Moise shows the upper conductive layer (51) comprising a lower electrode of a capacitor (col. 9, lines 27-29).

8. Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chang, Taguwa and Moise applied to claim 25 above, and further in view of Nagasaka.

Regarding claim 30, the device with combined teachings of Chang, Taguwa and Moise shows substantially entire claimed structure except a tapered contact plug. Fig. 19D of Nagasaka shows a tapered contact plug 12.

It would have been obvious to one of ordinary skill in the art at the time of the invention to form a tapered contact plug of Chang with Nagasaka's teaching in order to form the plug without cracks. It is also well known in the art that it is easier to fill contact/plug openings with tapered sidewalls.

9. Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being obvious over Chang.

Regarding claim 6, Chang does not explicitly disclose the thickness of the ohmic layer as

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claimed. However, it would have been obvious to one of ordinary skill in the art at the time of the invention to have an intended range of the thickness for an ohmic layer as in pending claim, since it would have been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only in routine skill in the art. *In re Aller*, 105 USPQ 233.

Regarding claim 7, Fig. 1 of Chang does not explicitly show the thickness of the liner layer as claimed. However, it would have been obvious to one of ordinary skill in the art at the time of the invention to have an intended range of the thickness for an liner layer as in pending claim, since it would have been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only in routine skill in the art. *In re Aller*, 105 USPQ 233.

(11) Response to Argument

Appellant's arguments have been fully considered but are not found persuasive.

A. Appellant argues that Claims 4 and 25 are Patentable

1. Appellant mainly argues that "the layer 24 shown, for example, in FIG. 1 of Chang, is not an ohmic layer, but instead a titanium glue layer used to enhance the adherence of the titanium nitride barrier layer."

First, spanning on page 4, line 23 of the specification, the instant invention discloses "A Ti ohmic layer 14 is formed between the TiN liner 16 and the insulating film 22, and between the TiN liner 16 and the conductive region of the semiconductor device 12."

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FIG. 1 of Chang shows an identical structure formed with identical materials: FIG. 1 of Chang shows a Ti layer 24 is formed between the TiN liner 26 and the insulating film 20, and between the TiN liner 26 and the conductive region 14 of the semiconductor device 10.

Second, starting on page 6, line 7 of the specification, the instant invention further discloses that “The ohmic layer 120 may comprises a Ti film formed using plasma enhanced CVD (PECVD), collimator sputtering, IPVD, or physical vapor deposition (PVD).”

Chang discloses an identical process to form a Ti layer: Chang discloses that “The glue layer preferably is composed of titanium 24 and is deposited by chemical vapor deposition (CVD) or physical vapor deposition (PVD).” See column 3, lines 8-10.

Therefore, there is no structural or material difference between the pending claim and the reference to Chang.

2. Applicant contends that “the layer 24 shown, for example, in FIG. 1 of Chang, is not an ohmic layer, but is instead a titanium glue layer used to enhance the adherence of the titanium nitride barrier layer 26.”

First, it is well known in the art that a titanium layer is used to improve the adherence of a titanium nitride barrier layer.

Second, the instant invention discloses the titanium layer is formed on the titanium nitride barrier layer.

Therefore, it implies that the titanium layer in the instant invention is also used to enhance the adherence of the titanium nitride barrier layer.

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3. Appellant further contends that “a titanium glue layer is not an ohmic layer as it does not reduce the resistance difference between titanium nitride barrier layer 26 and source/drain region 14.”

Such arguments should not be deemed to be persuasive. Merely because the reference to Chang does not specifically mention the term “ohmic,” it should not be construed to mean that the titanium layer 24 is not an “ohmic layer.” As explained previously, there is not a single structural or material difference between Claim 1 and Chang. Therefore, how is Appellant’s titanium layer “ohmic” but not Chang? As is clear from Appellant’s arguments, there is no difference. Appellant is merely relying on a single word missing from the disclosure of Chang for sake of argument. Clearly, if the titanium layer of Appellant’s invention is “ohmic” then Chang’s titanium layer must likewise be “ohmic” whether he uses this term or not, and if Chang’s titanium layer is not ohmic, neither is Appellant’s.

B. Appellant argues that Claim 5 is Patentable

Issue of claim 5 is identical to that of claim 4 since claim 5 is dependent on claim 4.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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jmi

August 4, 2004

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